Real-time Monitoring Sensors and Station - Things to Consider

Communication: *How will sensors and stations transmit data?*

- Cellular – Verizon Network

Sensor / Station Setup: *Which sensors should be used and where should they be established? Compatibility issues?*

- Rain Gauge Sensor – Tipping Bucket
- Water Level Sensors – Submersible Pressure Transducer
- Camera Sensor
- Road-side Warning System – Flashing Beacons
- "Packaged" station to reduce costs and maintain compatibility – Water level Stations

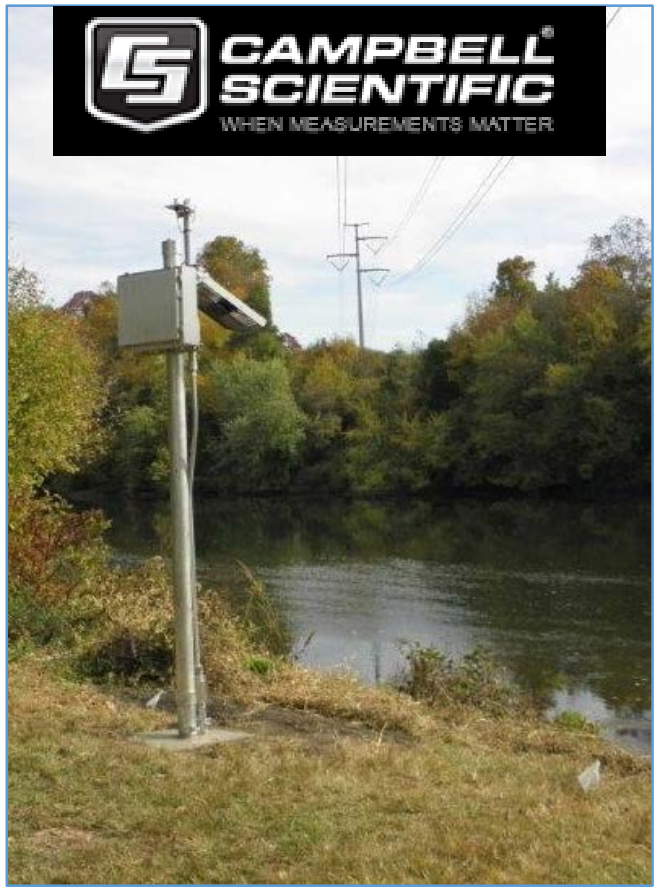
Installation: *What are best installation practices to create sustainable system?*

- Shallow streams – installation guides have been provided by Mecklenburg / Charlotte "Low Cost Flood Sensors: Urban Installation Guidebook"
- Permanent installation vs. Portability –Stations and Sensors will be post-mounted with cabling extending to stream/river.
- Public vs. Private land – Most sites will be within public road ROWs. Coordinate with Highway Department, Towns, or land owners and establish agreements.
- Security – determine best practice to deter theft or vandalism, especially for road-side stations.
- Site Suitability – Ensure that site has adequate sun exposure and is free of vegetation that would cause accessibility issues for regular maintenance.

Data Management Services: *How will Data be stored and served? What are data management capabilities?*

- Vendor Provided Software Platform – Data Dashboard
- Third-Party Services Capability (NWS, Datawise, Weather Underground etc.)
- Alert Notification Capability

Equipment –Stations and Sensors



Cost Comparison

Equipment Costs	Intellisense	High Sierra Electronics	Campbell Scientific
Station including accessories (Solar and Battery Power, Enclosures, Mounting brackets, etc.)	$2595	$2704	$3154
Water Level Sensor (Pressure Transducer) w/50ft cable	$400	$1267	$1128
Rain Gauge Sensor w/Mounting Bracket	$1500	$955	$582
Setup 1: Water Level Station	$2995	$3971	$4282
Setup 2: Rain Gauge Station	$4095	$3659	$3736
Setup 3: Water & Rain Level Station	$4495	$4926	$4864
Data Costs	**Intellisense**	**High Sierra Electronics**	**Campbell Scientific**
Verizon Cellular Data Plan - Annual Cost per Station	$84	$102	$144
Software / Dashboard - Annual Subscription Fee	No Cost subject to change as platform grows	$240 / station / year	$790 (one-time cost)
Data Sharing - Annual Service Fee	No Cost	$350 / station / year	No Cost
Additional Features	**Intellisense**	**High Sierra Electronics**	**Campbell Scientific**
Warranty	1 year	2 years	3 year for station, 1 year for sensors
Third Party Software Capability	Yes	Yes	Yes
Alert Notification Capability	Yes	Yes	Yes
Additional Sensors – third party sensors	Yes	Yes	Yes

Little La Crosse River Watershed – Equipment Cost Estimate

Site 1. Town of Leon – Jancing Avenue Crossing
Setup 1: Water Level Station (+ Camera Sensor, + Road-side Warning System)

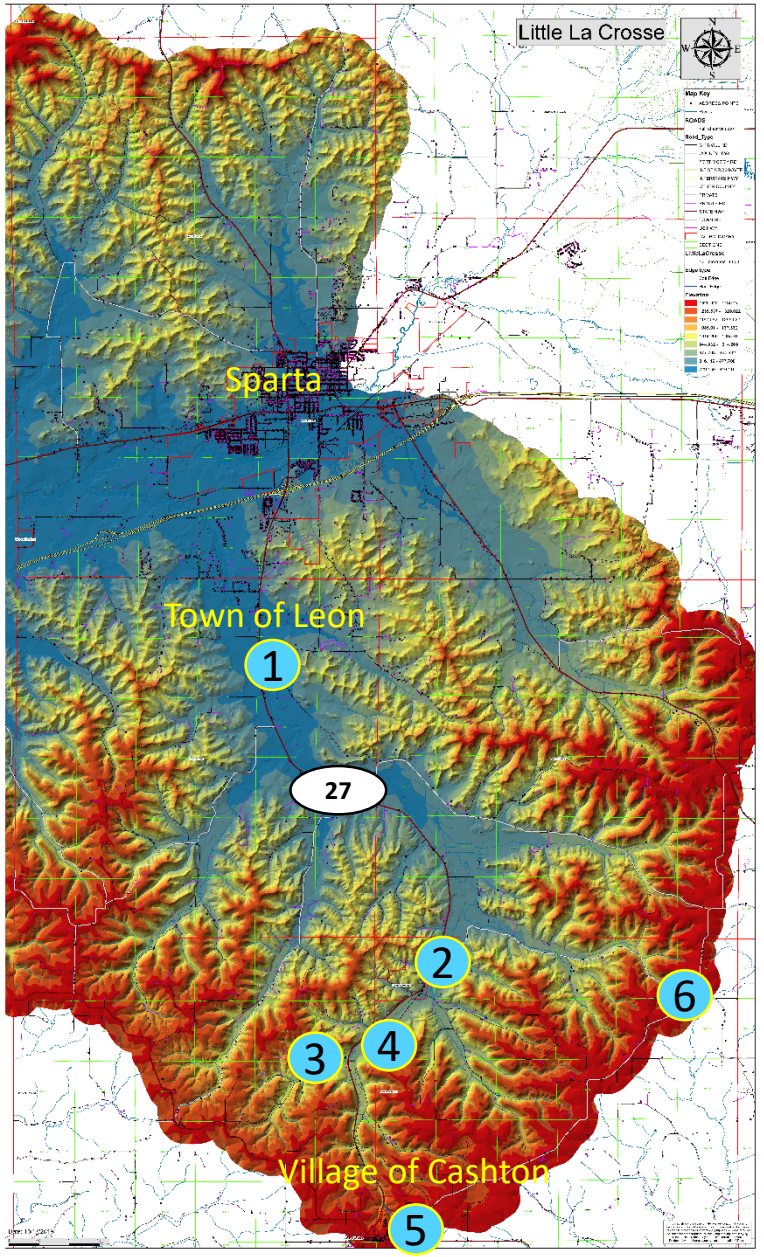
Site 2. County Road F Crossing
Setup 1: Water Level Station (+ Camera Sensor)

Site 3. Nebraska Avenue Crossing
Setup 1 : Water Level Station

Site 4. Market Road Crossing
Setup 1: Water Level Station

Site 5. Village of Cashton
Setup 2: Rain Gauge Station

Site 6. St. Mary's Ridge
Setup 2: Rain Gauge Station – Included in Kickapoo Watershed Estimate



Equipment Costs	Quantity	Intellisense	High Sierra Electronics	Campbell Scientific
Setup 1: Water Level Station	4	$11,980	$15,884	$17,128
Setup 2: Rain Gauge Station	1	$4,095	$3,659	$3,736
Setup 3: Water & Rain Level Station	0	$0	$0	$0
Total Cost	**5 Stations**	**$16,075**	**$19,543**	**$20,864**
Data Management Costs (1st Year)	5 Stations	$420	$1,710 - $3,460	$1,510

Kickapoo River Watershed – Equipment Cost Estimate

Site 1. Village of Norwalk – Railroad St. Crossing
Setup 1: Water Level Station

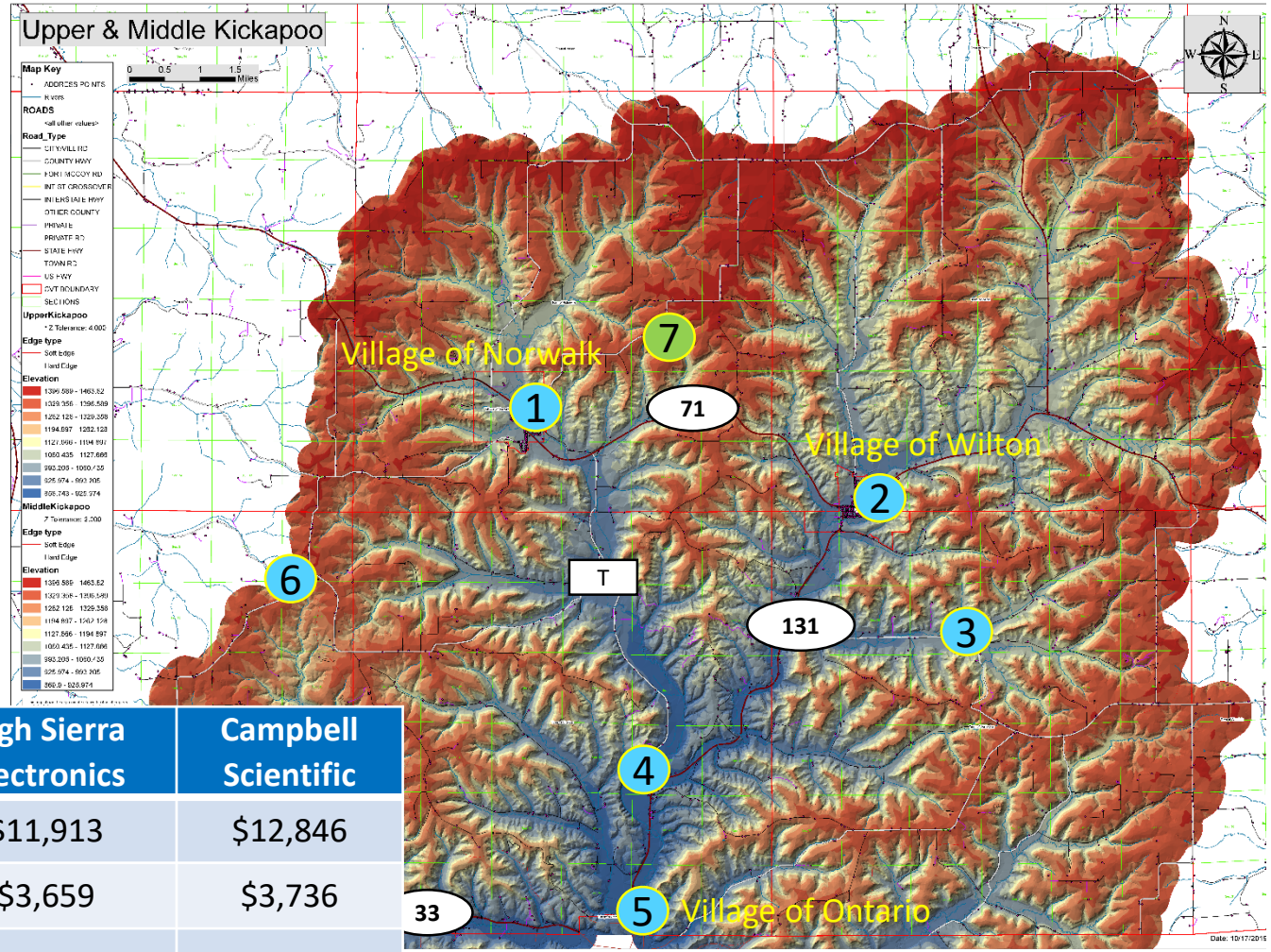
Site 2. Village of Wilton – St. Hwy 71
Setup 1: Water Level Station

Site 3. County Road Z
Setup 3: Water & Rain Level Station

Site 4. County Road T Crossing
Setup 1: Water Level Station

Site 6. St. Mary's Ridge
Setup 2: Rain Gauge Station

Site 5, 7, & 8 Existing Stations



Equipment Costs	Quantity	Intellisense	High Sierra Electronics	Campbell Scientific
Setup 1: Water Level Station	3	$8,985	$11,913	$12,846
Setup 2: Rain Gauge Station	1	$4,095	$3,659	$3,736
Setup 3: Water & Rain Level Station	1	$4,495	$4,926	$4,864
Total Cost	**5 Stations**	**$17,575**	**$20,498**	**$21,446**
Data Management Costs (1st Year)	5 Stations	$420	$1,710 - $3,460	$1,510

Equipment Cost Estimate Summary (2 Watersheds)

Equipment Costs	Quantity	Intellisense	High Sierra Electronics	Campbell Scientific
Setup 1: Water Level Station	7	$20,965	$27,797	$29,974
Setup 2: Rain Gauge Station	2	$8,190	$7,318	$7,472
Setup 3: Water & Rain Level Station	1	$4,495	$4,926	$4,864
Total Cost	**10 Stations**	**$33,650**	**$40,041**	**$42,310**
Data Management Costs (1st Year)	10 Stations	$840	$3,420 - $6,920	$2,230

ADDITIONAL NOTES:

- Road-side Warning Systems are not included in cost estimate.
- Additional sensors such as camera or soil moisture sensors are not included in cost estimate.
- Installation costs have not been estimated. Charlotte-Mecklenburg estimated about $100 per site for materials and 3 hours of labor for installation and equipment setup per site.
- Shipping costs and any additional service fees have not been included in cost estimate.
- Data management costs are subject to change.
- Additional stations and sensors will be added as funding becomes available.

Intellisense - AWARE Flood Sensor

Internet of Things (IoT): Low-Cost Flood Inundation Sensors

Homeland Security
Science and Technology

EARLY WARNING FLOOD SENSORS

Flooding is the nation's leading natural disaster, accounting for the greatest loss of life, property damage and economic impact. Current flood damage for the 30 year period (1985-2015) is estimated at $8.2 billion in damages and more than 105 fatalities per year. Deployable Internet of Things (IoT) technology monitors flood-prone areas in real time for rapid detection to alert officials, industry and citizens to potential threats can enhance investments in flood mitigation.

GOVERNMENT, INDUSTRY MEETING COMMUNITY NEEDS

Over the last three years, the Department of Homeland Security Science and Technology Directorate (S&T) worked with companies that were awarded Small Business Innovation Research (SBIR) funds to design, develop and test a network of inexpensive, deployable flood inundation sensors. The sensors were part of a scalable wireless mesh network that rapidly measures rising water and can report flood conditions back to operations centers, first responders and citizens.

AWARE Flood sensor with IoT communications module (LTE-M) and plug-n-play water level pressure sensor.

The Flood Sensor Project includes three phases:

- SBIR Phase 1: Developed prototype flood sensors.
- SBIR Phase 2: Refined Phase 1 prototypes to harden the sensor housing, increase power through energy harvesting, expand communications network range, transmit imagery, provide GPS location, implement open data exchange standards and monitor performance diagnostics. In 2018 and 2019, more than 600 sensors were deployed to eight state/local jurisdictions for operational test and evaluation.
- SBIR Phase 3: S&T down-selected to one small business based upon Phase 2 stakeholder feedback and commercial viability. Additional enhancements and sensors will be deployed to new jurisdictions for further evaluation and commercialization.

PHASE 3 FOCUS: PRODUCTION AND COMMERCIALIZATION

SBIR Phase 3 will result in the development of modular sensors designed for maximum configuration flexibility to meet stakeholder environmental conditions. The goals of SBIR Phase 3 include:

1) Extend flood sensor functionality to incorporate additional enhancements identified by stakeholders during SBIR Phase 2 field tests and evaluation.

2) Develop QA/QC performance testing and validation procedures to address a number of key parameters for each of the sensor sub-systems (e.g., sensing capabilities, power, communications, data transmission, mounting / installation and construction).

3) Demonstrate a scalable, production-ready manufacturing capacity for volume-based sensor production.

4) Perform operational field tests and evaluation with selected state, local and international stakeholder jurisdictions.

Once completed, these systems can be deployed for years with little-to-no maintenance. Sensor costs, depending upon configuration, are expected to be orders of magnitude less expensive than many permanent flood sensors used today.

INDUSTRY PERFORMER SENSOR PROFILE

Intellisense Systems' AWARE Flood is a real-time, water monitoring system that supports a self-healing mesh topology of sensor nodes with submersible flood sensors via a variable length cable to monitor waterway conditions. It operates autonomously via continuous solar and battery power, communicating wirelessly between nodes and emergency data centers using satellite, radio, or cellular networks. (www.intellisenseinc.com)

AWARE Flood Featured on the Local News in Charlotte for Alerting Residents to Flash Flooding

February 7, 2020

Over 100 AWARE Flood Sensors are installed in northern Charlotte to warn residents of flash floods during heavy rain events.

intelliSENSE SYSTEMS
Tomorrow's innovation today

News Release

Intellisense Systems Awarded $3.26M Department of Homeland Security (DHS) contract for AWARE Flood Inundation Sensors

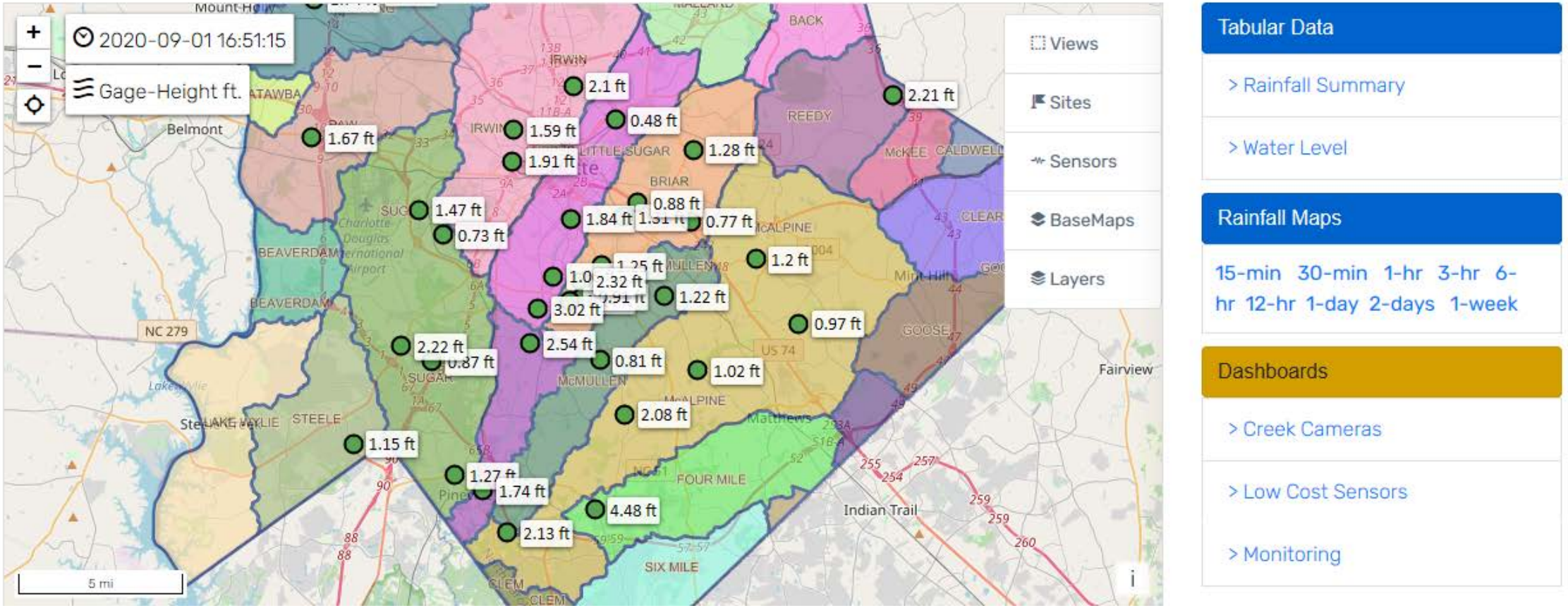
AWARE flood inundation sensors notify first responders with alerts and warnings using Internet of Things (IoT) Wireless Emergency Alerts

Intellisense - AWARE Flood Sensor

Flood Information Notification System

Mecklenburg County Real-time Rainfall, Stream, and Reservoir Data

The U.S. Geological Survey and Charlotte-Mecklenburg Stormwater Services cooperatively support a surface water data-collection and real-time storm tracking network. Real-time data from that network is collected and displayed using this Contrail Application.



The FINS network consists of 54 stream level sensors and 72 rain gauges.
Mecklenburg County is 546 sqmi. for comparison, Monroe County is 908 sqmi.